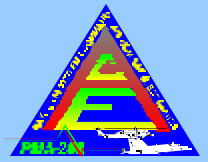


CNS/ATM for Naval Aviation

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Purpose

This newsletter provides information to the Naval aviation community concerning requirements, issues, and developments in Communications, Navigation and Surveillance / Air Traffic Management (CNS/ATM).

COMMUNICATIONS

Controller Pilot Data Link Communications (CPDLC)

Existing voice communications for controller-to-pilot communications have several limitations. These include congestion on busy voice channels, difficulty in understanding voice transmissions due to channel interference, difficulty in understanding due to language differences between pilot and controller, and human error from misunderstood voice instructions. Additionally there are the issues of manual copying of information, error in readback, and a need to speed up the exchange of information between air and ground. Human factors experiments suggest that data links increase air traffic control efficiency, reduce communications error, improve management efficiency of airspace, and reduce pilot workload.

Controller Pilot Data Link Communications (CPDLC) are being developed to provide the capability for controllers and pilots to exchange digital information via data links. CPDLC will augment current voice communications capability, not replace it.

In 1983, ICAO chartered the Special Committee on the Future Air Navigation System (FANS) to study traffic infrastructure and recommend changes to support anticipated growth in air traffic over the next 25 years. Their 1988 plan advocated a change from terrestrial-based technology to space-based technology, taking advantage of digital communications for data exchange. As currently implemented, FANS equipped aircraft broadcast their GPS-based position automatically every 5 minutes via oceanic data link (ODL). Digital data communications using ODL coupled with the greatly increased navigational accuracy inherent in GPS substantially reduces the possibility of errors and allows for

significantly reduced aircraft separations. In turn, this allows additional aircraft to fly at optimum altitudes, burning less fuel, and reducing their cost of operation.

Prior to FANS and GPS, 120 NM longitudinal separation and 100 NM lateral separation were routine for oceanic flight due to navigation inaccuracies, the lack of an active surveillance mechanism, and coupled with delays associated with relayed HF communications. Currently, the lateral separation requirement in FANS capable portions of the Pacific has been reduced to 50 NM lateral spacing. Plans for the Pacific area FANS tracks include a reduction to lateral and longitudinal spacing of 30 NM.

A joint US, Australia, New Zealand, Tahiti, and Fiji effort, along with participation by Boeing, United Airlines, Air New Zealand, and Qantas, was implemented using a satellite data link for beyond-line-of-sight controller-pilot communications in the Pacific area. Two telecommunications providers, ARINC, Inc. and SITA, are playing integral roles in this effort known as FANS 1/A. The ODL system, now operational in the Pacific CNS/ATM tracks, relies on the INMARSAT satellite network. This ODL is being expanded into North Atlantic tracks at New York Center. Note that FANS 1/A denotes implementation of particular capabilities aboard aircraft manufactured by either Boeing or Aerospatiale.

With the FANS-1/A ODL, pilots exchange messages directly with controllers using a display and pre-formatted ICAO message sets over INMARSAT. This replaces the use of HF voice radio, which required a service provider, such as ARINC or SITA, to receive the voice message from the pilot, and retransmit it to an Air Route Traffic Control Center (ARTCC) via teletype. Thus, ODL improves the reliability and speed of controller-to-pilot communications. Since an INMARSAT message is relatively expensive, the possibility of using HF Data Link for CPDLC is being considered by some airlines, especially for polar operations where there is inadequate satellite coverage.

It is intuitively obvious that the use of CPDLC alleviates many of the limitations of voice communications. It reduces traffic on busy channels, thereby freeing the channel for critical voice communications. With a textual display, difficulties in understanding due to channel interference and language proficiencies are reduced. In fact, the message can be converted into displaying the pilot's native language using appropriate software. Misunderstandings due to interpretation

of voice instructions are reduced. With the ability to recall messages from memory, manual copying errors and readback errors are eliminated. The only drawback is a reduction in information obtained by listening to instructions given to other aircraft, that is, reduced access to the “party line.”

Within the US, a VHF line-of-sight CPDLC data link is currently being developed. Chartered by the FAA Administrator’s National Airspace System (NAS) Modernization Task Force in 1997, a Data Link Issues Team identified and resolved issues that were slowing the implementation of data link technologies into the NAS. In 1997, the Team achieved a government/industry consensus path to implement CPDLC in the en route domain using three builds, Builds I, II, and III. This approach was considered by RTCA which formally recommended that the FAA adopt the Team’s recommended path only through Build II rather than through Build III. The recommended path formed the basis for the FAA’s Joint Resource Council’s (JRC) approved acquisition strategy for Builds I and IA. A Build II decision was postponed by the FAA until calendar year 2000.

CPDLC Builds I and IA are interim capability milestones to demonstrate line-of-sight CPDLC. The FAA will be using the VHF Data Link Mode 2 (VDL-2) service provided by ARINC or SITA for CPDLC air-to-ground communications through Build II. CPDLC Build III will transition to VHF Data Link Mode 3 (VDL-3). VDL-3 is a function included in the FAA’s Next Generation Communications (NEXCOM) System. Each build will comply with applicable ICAO Aeronautical Telecommunications Network Standards And Recommended Practices (SARPS). VDL-2 is designed using CSMA (Carrier Sense Multiple Access) architecture while VDL-3 is designed using TDMA (Time Division Multiple Access) architecture.

For deployment at the Miami ARTCC, CPDLC Build I is being developed by the FAA and other participants to validate CPDLC architecture, concept of operations and procedures. The Build I IOC for Miami is anticipated to be June 2002. Four message services will be implemented: transfer of communication, initial contact, altimeter setting, and free text, capable of being tailored for a specific controller’s terminal. A human factors end-to-end demonstration is planned by December 2000. American Airlines will be the initial airline to use the Build I message service.

CPDLC Build IA will increase number of CPDLC message services to approximately 18, including pilot initiated messages. With an estimated IOC of June 2003 at a key site (also Miami), Build IA is planned to become operational in all 20 domestic ARTCC’s. National deployment will begin in January 2004 with installation completed in January 2006. Some important objectives of the national deployment of Build IA are to gain increased acceptance of CPDLC by controllers and pilots while refining operational procedures.

Also using VDL-2, Build II continues the development of CPDLC. Currently Build II is expected to expand the message services to approximately 118. The Build II oceanic subnet (e.g., beyond line of sight data link) is undetermined. The FAA JRC has not determined an implementation strategy and schedule for Build II.

CPDLC Build III is envisioned to be an expansion of the Aeronautical Telecommunications Network message set and use the NEXCOM radio (VDL-3). Build III also has not yet been approved for implementation by the FAA.

Below is an implementation schedule of the various builds. Since the FAA has not approved implementation strategies for both Build II and Build III, the dates provided below are notional and should not be used for planning purposes.

CPDLC Approximate Implementation Schedule			
Capability	Details	Altitude	When
Existing VHF Voice	Analog voice	>24,000 ft	Now - 2009
		<24,000 ft	Now - 2012
Build I	CSMA digital data, analog voice	>24,000 ft	2002 - 2003
Build IA		>24,000 ft	2003 - 2006
Build II		>24,000 ft	2005 - 2008
Build III, Segment 1	TDMA digital voice, CSMA digital data	>24,000 ft	2008 IOC ?
Build III, Segment 2	TDMA voice and data	>24,000 ft	2009 IOC ?
Build III, Segment 3		<24,000 ft	2012 IOC ?

In Europe, a parallel CPDLC development effort, Link 2000+, is underway and is also using VDL-2. In addition, the Europeans are conducting operational flight trials of CPDLC with a number of airlines, including American Airlines, using VDL-2 in their Preliminary EUROCONTROL Test of Air/ground data Link, Phase II (PETAL 2) Program. PETAL 2 has implemented over 44 messages. The FAA is participating with EUROCONTROL on the PETAL Interoperability Team to ensure that avionics developed for CPDLC will be interoperable in both Europe and the U.S. Link 2000+ will not be deployed before 2007.

The PMA-209 CNS/ATM team is funding design changes to the AN/ARC-210 radio (RT-1794(C)) to include embedded VDL-3 functionalities. Availability is expected in FY04. The manufacturer, Rockwell Collins, is also developing a strap-on VDL-2 functionality that can be used with the RT-1556(B) as well as the RT-1794(C). The strap-on increases the overall height. Availability is expected by FY02.

In a future newsletter, CPDLC message services will be discussed in detail.